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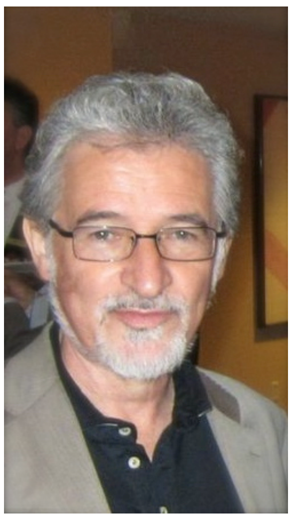

Dr. Kevin Bedell
Rourke Professor of Physics - Boston College
Vice Provost for Research, Boston College

Superfluid Fluctuations Above TC: An alternative path to the "Nearly Perfect Fermi Fluid"

Tuesday, August 4, 2015
2 - 3pm
MSL Auditorium (TA-03 - Building 1698 - Room A103)

Abstract: There has been considerable recent progress both experimentally and theoretically in the study of transport properties in strongly interacting ultracold atomic Fermi gasses close to the superfluid phase transition temperature, TC. This has contributed to our understanding of "perfect quantum fluids." These perfect fluids include, cold atomic Fermi gases, dense nuclear matter produced in heavy ion collisions, and in the cores of neutron stars. A "perfect quantum fluid" is one in which the ratio, R ~ (shear viscosity/entropy density), achieves a minimum value of about (1/4pi) as a function of temperature as predicted from String Theory! It is an appealing conjecture that the behavior of a perfect or nearly perfect quantum fluid is the same regardless of the orders of magnitude between the densities and temperatures of the cold atom gases and say the quark gluon plasma produced in heavy ion collisions. Before jumping to such "lofty conclusion" we wanted to see if a more traditional approach to strongly interacting Fermi fluids can explain the minimum in R. We developed a new and relatively simple theoretical model to calculate the quasiparticle scattering rates from the weak to the strong coupling regime (the unitary limit) of a Fermi liquid above TC. What we have found in our theory is that we obtain a local minimum in the ratio R and another transport coefficient, the spin diffusion, for T above TC by an interplay between Fermi liquid effects that want the transport coefficients to diverge, as T -> 0, and the superfluid fluctuations that want to drive them to zero at TC, as T - > TC, from above. We end with a question: Is the minimum found in the transport coefficients of the "nearly perfect Fermi liquids" due to universal quantum behavior or is it a consequence of some fluctuations arising from a nearby superfluid transition in a strongly coupled Fermi liquid?

Biography: Kevin S. Bedell is the John H. Rourke Professor of Physics at Boston College (BC). Long before coming to BC he received his Ph.D. in Physics, from SUNY Stony Brook, NY, August 1979, his thesis advisor was Gerry Brown. Kevin did his first postdoc with David Pines, at the University of Illinois, September 1979 – January 1982. He returned to Stony Brook as a Research Associate, in the Institute for Theoretical Physics, ITP (now called the Yang ITP) from September 1982 – August 1985. After this he spent a year as a visiting Assistant Professor at the Kamerlingh Onnes Laboratory, in Leiden. After this seven-year period "on the road" he became a Staff Member at LANL, in the group, T-11 (now T-4), September 1986 – January 1996. During this period he became the Deputy Director of the Advanced Studies Program in High Temperature Superconductivity and then Director of the Program in Correlated Electron Theory. During the LANL years Kevin became a Fellow of the American Physical Society in 1993 and started as an Editor for Advances in Physics, November 1995 – present. After this long period on the Mesa, Kevin started a new job as Chair, of the Department of Physics, at Boston College, September 1995 – September 2006. He was appointed the Vice Provost for Research, October 2006 – August 2010, and returned to the Faculty in 2010. His research interests involve the application of many body theory and Fermi liquid theory to a variety of quantum fluids, the electron gas, liquid 3He and 3He-4He, cold atom Fermi gases, heavy fermion and Hi-TC superconductors, nuclear matter, exotic ferromagnetic metals and superconductors, and Dirac materials (graphene).

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